Regional Thermal-Fluid-Flow Modelling: Predictive Targeting Outcomes

Warren Potma and Yanhua Zhang (CSIRO)

Central Gawler Gold Province Modelling Project Update

Poster #2

pmd*CRC

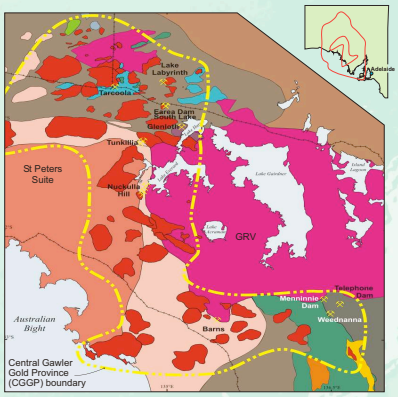
Predictive Targeting Outcomes:

- ***Rocks within ~200 vertical metres of the base of the Gawler Range Volcanics (GRV) "seal" are potentially the most prospective.***
- ***Reactive rock types, as defined by the geochemical modelling (mafics and carbonaceous sediments), in close proximity to the base of the GRV, also add to the prospectivity.***
- ***Significant steep structures intersecting or abutting the base of the GRV increase the probability of mineralisation as they provide a focussed deep fluid source to the base of the GRV and potentially provide a zone for this deep hot fluid to mix with the cooler lateral fluid flow beneath the GRV.***
- ***Damage zones in the lower GRV are also potential mineralisation hosts (especially when hosted by more mafic units of the Lower GRV, as they are an ideal geochemical trap for Au fluids). These damage zones may be triggered by intersecting faults/shear zones or localised fluid overpressure (from blind structures or shallow level Hiltaba intrusives etc.).***
- ***Segments of major steep faults proximal to Hiltaba intrusions may be sites of more vigorous up-flow and mineral precipitation.***
- ***There is no reason why the prospective area for gold dominant deposits, and therefore the delineation of the CGGP, should not extend Eastwards under the GRV. The challenge now being how to use the predictive modelling in conjunction with geophysical interpretation and forward modelling to generate valid targets below the thinner portions of the GRV.***

Aim of thermal-fluid-flow modelling:

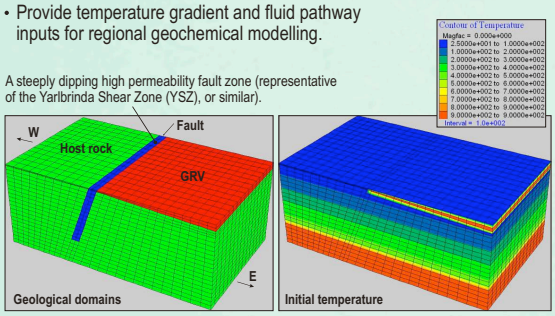
Large scale 3D coupled thermal-fluid-flow modelling was undertaken in order to:

- Understand the impact of the Gawler Range Volcanics/Hiltaba thermal event (igneous and volcanic) on regional thermally driven fluid flow.
- Identify fluid pathways, and where thermally driven fluids are likely to focus.
- Identify where the high thermal gradients are, and how they interact with fluid flow.
- Provide temperature gradient and fluid pathway inputs for regional geochemical modelling.

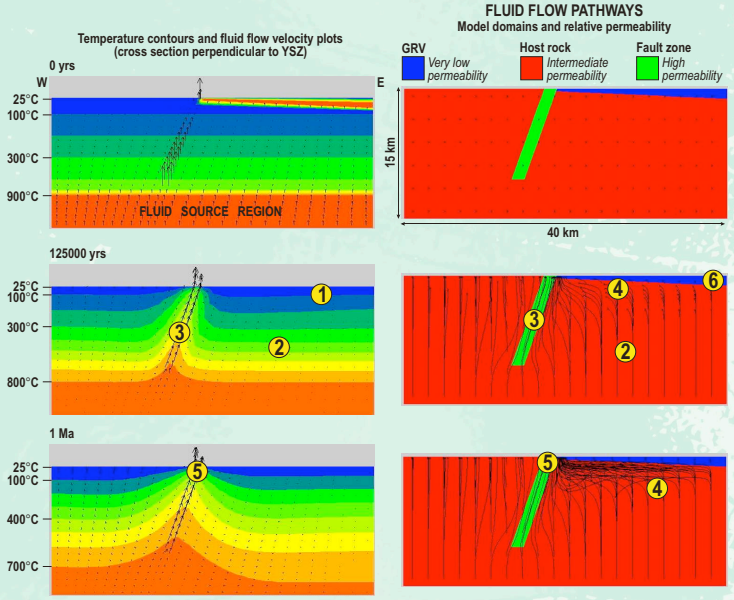


Arguably, all significant mineralisation in the region resides (at least in part) within the zone immediately below the GRV (Tarcoola, Glenloth, Earea Dam, Tunkillia, Nuckulla Hill, Barnes, Menninnie Dam, Weednanna and, potentially, the deposits of the Olympic Dam IOCG province to the NE of the current GRV outcrop).

A steeply dipping high permeability fault zone (representative of the Yarlbrinda Shear Zone (YSZ), or similar).



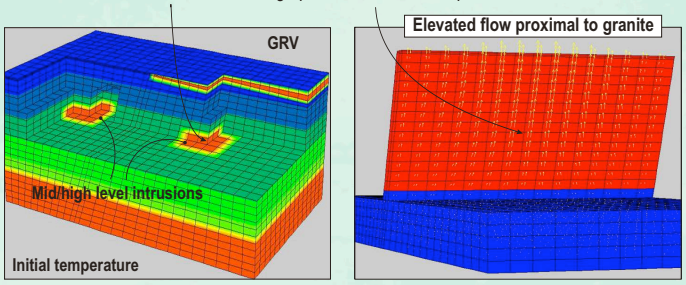
- Initial geothermal gradient of 30°C/km throughout model.
- The model is instantaneously overprinted by 900°C GRV extrusive blanket with very low permeability, and a 5km thick, 900°C, slab across the base of the model to represent the Hiltaba/GRV thermal source.



Cross sections through model at various time steps

1. The medium to long term thermal impact of the thin (<2km) GRV blanket is negligible.
2. Slower rock buffered flow. Potential dissolution source for ore minerals, particularly if hot fluids pass through mafic rock sequences.
3. Rapid fluid buffered flow, fluid chemistry similar to source
4. Focussed lateral flow (isobaric and isothermal) seeking to escape from under impermeable GRV, either through ruptures or by flowing to GRV margins.
5. Potential 2 fluid mixing zone (cooler rock buffered fluid and hotter fluid with chemistry similar to source).
6. The GRV forms an impermeable blanket that forces focussed lateral flow in the rocks immediately beneath the GRV.

High level Hiltaba-aged intrusives proximal to steep shear zones/faults can locally perturb the flow field within the fault increasing up-flow within the fault proximal to the hot intrusion.



If the intrusive is big enough it may trigger convection within the fault. Either of the above may explain, or help to predict, periodicity of alteration and/or mineralisation along major faults such as the Yarlbrinda Shear Zone.

High level Hiltaba-aged intrusives proximal to the base of the GRV could also provide a mechanical, thermal and/or fluid pressure anomaly to localise mineralisation.

The laterally extensive very low permeability blanket created by the GRV is critical to the focussing of thermally driven regional fluid flow.

- The lower GRV is visibly deformed and locally altered in outcrop and contains mafic units (identified as ideal gold traps for the Hiltaba Gold Fluids by the geochemical modelling) .
- If deformation or locally over pressured fluids have ruptured the lower GRV (especially mafic units) there is significant potential for gold (and other) mineralisation in the lower GRV.
- Topography on the basal contact of the GRV may also result in preferred flow paths immediately below the contact. Such topography is indicated in the Olympic Dam Seismic line to the NE.

More information:

https:/pmd-twiki.arrc.csiro.au/twiki/bin/view/PIRSA/WebHome

pmdCRCp002-06

CSIRO

Government of South Australia
Primary Industries and Resources SA

Australian Government
Geoscience Australia